shaft it is possible without variation in the rate of rotation to make observations at the very beginnings of phosphorescence and to compare by simultaneous vision, the appearances, just before and immediately after the close of excitation, or on the other hand the earlier with the later stages, up to about .004 second. The photometer, spectroscope, spectrophotometer, camera, etc., may all readily be used with this form of phosphoroscope and studies of the most varied character become possible.

The instrument has already been employed in various determinations, some of the results of which have been reported elsewhere.

To study the change of color during the decay of phosphorescence in the case of certain sulphides, color photographs[15] by the Lumière process were taken, first of the glowing surface as it appeared through the sectored disk at full speed and then for comparison with the disk revolving very slowly.

To determine the effect of temperature the tube containing the sulphide was mounted within a cylindrical dewar bulb, and the lower end cooled to the temperature of liquid air. By keeping the upper end of the tube at + 20° C. a sharp temperature gradient along the axis of the tube was maintained and the very striking changes of color when the substance, under these circumstances, was excited to phosphorescence were photographically recorded.

Spectroscopic comparisons of the spectrum of the light emitted by the uranyl salts during fluorescence and at various stages during phosphorescence have been made with this phosphoroscope[16] and it has been found especially well adapted to the determination of the decay of phosphorescence in cases where, as in that of the uranyl salts, the entire process occupies only a few thousandths of a second.

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CORNELL UNIVERSITY,
May, 1916

[15] Paper read at the April meeting of the American Philosophical Society, 1916.

[16] Nichols, *Proc. Nat. Acad. of Sciences*, 1916.

SCIENTIFIC QUEEN REARING

HAVING been engaged for several years in practical breeding of thoroughbred queens for commercial use, and realizing the certainty and definiteness of results if "Mendel's laws of heredity could be applied to bee breeding, I undertook to determine, if possible, the manner in which some of the most valuable traits of the different races of bees were transmitted through heredity, with the idea of combining in one strain of bees those qualities of recognized desirability, such as hardiness, prolificness, longevity, length of tongue and wing expanse. Color also was brought under observation as a means by which segregation could be more readily seen if it occurred in the second filial generation, as observed by Mendel in coat color of peas when a green-seeded variety was crossed on a yellow-seeded sort, in his experiments with the garden pea.

I was therefore much interested to see that Professor Newell, of College Station, Texas, was working along the same lines.[1] The conclusions at which he arrives, in some instances, do not accord with the facts brought out in a series of breeding tests that were conducted to determine certain (the same) characteristics.

Dzierzon was the first, I believe, to point out that drones were of the same zygotic constitution as the mother alone, and were produced parthenogenetically, the correctness of which is supported by some very convincing evidence, obtained by other reliable experimenters in the same field. Professor Newell says:

> Pure Italian queens mated to Carniolan drones produce only Italian drones, and Carniolan queens mated to Italian drones produce only Carniolan drones. This is strictly in accordance with the theory of Dzierzon, the daughters of Italian queens which have mated to Carniolan drones produce both Italian and Carniolan drones, produce them in equal numbers, and do not produce any other kind. (?) This is in accordance with the theoretical expectation under Mendelian law. (?)

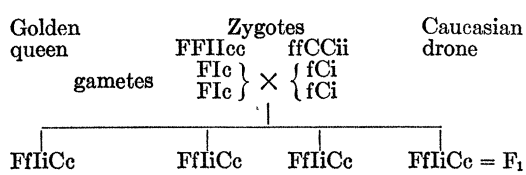
[1] See "Inheritance in the Honey Bee," SCIENCE, N. S., No. 1049, pages 218–219, February 5, 1915.

If the constitution of a pure Italian queen be represented by II and of a pure Carniolan queen by CC, the former will produce gametes I and I, and the latter, gametes C and C, these being Italian and Carniolan drones respectively. (?)

These conclusions of Professor Newell are not verified in so far as I have been able to judge from the results obtained by breeding tests that I have made in various ways with drones reared from heterozygous queens. The Gulf Coast prairies near Houston, Texas, are ideal for the complete isolation of mating stations. With little difficulty locations can be found where there are no trees or shrubs of sufficient size to harbor a swarm, within a radius of from five to seven miles, which allow matings to be made with a reasonable degree of certainty.

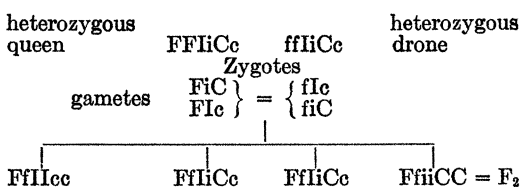
To determine the behavior of the color factor in transmission, a pure strain of golden Italians and gray Caucasians (bred from queens that I imported) were chosen with which to make the primary or initial cross, the former giving workers of the brightest yellow color, while the workers of the latter are distinctly gray without a trace of yellow on the abdominal segments.

The result of mating a golden queen to a Caucasian drone is shown by the following scheme.



all heterozygous females, colored like ordinary Italian workers, showing that yellow is dominant to gray, a result agreeing entirely with Professor Newell's observations of the F_1 Italian-Carniolan Cross. The gray (dark) or recessive color does not appear in this generation of workers, the reciprocal cross gives the same results.

When queens are reared from these F_1 larvæ they produce drones of the constitution IiCc the same as the mother, a fact verified by subsequent breeding tests. The following scheme shows the result of mating a heterozygous queen to a heterozygous drone.



females, as will be observed, segregation occurs in this generation in a true 1:2:1 Mendelian ratio, or one pure dominant, two heterozygous dominants and one pure recessive, a result similar to that observed by Mendel in the F_2 of his cross of a tall pea on a short or dwarf variety, in which he got one TT, two Tt, Tt and one tt, or (dwarf) recessive; so it is in the case of the F_2 workers, in appearance there are three that show the dominant or yellow color of the Italians and one in four is recessive, or gray in color. This feature is markedly noticeable when queens are reared from larvæ of this generation; of the number hatched, about 25 per cent. show the pure golden color, 50 per cent. appear as ordinary Italian queens, with about the same variation in general color (that these are heterozygous in constitution is proved when bred to recessive drones) and 25 per cent. of them show only the recessive color, and in subsequent breeding prove to be pure recessives and continue to breed true when mated to recessive drones. The differences in the color of the workers of this F_2 are not so accentuated as in the queen reared from the same larvæ. As shown the pure dominant queens are golden, the impure dominants intermediate in color, while the recessives are gray without any trace of yellow on the abdominal segments.

Since drones are produced parthenogenetically, we must consider the fact that the egg of the queen at maturation, when not fertilized, is reduced from the 2N (or NN) condition to the 2N — 1 (or 2N — 2) condition, showing that a whole set, N, of chromosomes is not eliminated in maturation, but only one or two chromosomes. Hence the male condition here is 2N — 1 or — 2. The condition of the gametes formed, however, is N in both sexes. Since in fertilization only 2N zygotes are produced, they are (in the case of bees) invariably females.

Therefore in parthenogenetic reproduction it seems that the chromosomes FF, or factors for femaleness, are eliminated at parturition, and the resulting zygote is a male. And so far, as observed by the tests of breeding (regardless of color) the F_1 females (queens) produce drones of the constitution ffIiCc, and are heterozygous for the factors I and C with the allelomorphs i and c, whether in queen or drone, and the only gametes that can be formed from these are IC Ic iC ic, when such individuals are bred together, heterozygous workers, as well as both *pure* dominants and *pure* recessives are produced, making it possible to recover the pure line of either race used in making the initial or primary cross.

CHARLES W. QUINN
HOUSTON HEIGHTS, TEXAS

SOCIETIES AND ACADEMIES

THE BIOLOGICAL SOCIETY OF WASHINGTON

THE 555th regular meeting of the Society was held in the Assembly Hall of the Cosmos Club, Saturday, April 22, 1916, and called to order by President Hay at 8 P.M., with 24 persons present.

On recommendation of the council George H. Clements, Washington, D. C., was elected to membership.

On recommendation of the council the following resolutions were read:

WHEREAS: Professor Wells W. Cooke, distinguished ornithologist, authority on bird migration, treasurer of the Biological Society of Washington, and an active member of the council of the society, has passed from this life, therefore be it

Resolved: That the Biological Society of Washington deeply regrets the death of one for many years so keenly interested in the affairs of the society, one who was a peculiarly efficient officer, a wise counselor and a charming companion, and extends its warmest sympathy to the family of Professor Cooke.

Signed N. HOLLISTER,
J. W. GIDLEY,
ALEX. WETMORE

Under the heading Brief Notes, Dr. Howard E. Ames commented upon a question raised at the 553d meeting as to the existence of a South American mammal having the mammæ on the dorsal surface of the body. He had ascertained that this condition existed in the coypu (*Myocastor coypu*). Dr. Ames also offered information in regard to another question propounded at the same meeting as to the ability of camels to swim: According to Dr. E. A. Mearns dromedaries used in Abyssinia were able to swim; and in a book by an English army officer of experience Dr. Ames had found a statement to the effect that camels were powerful swimmers. Comments followed by the chair and by Dr. L. O. Howard.

Under the same heading Dr. F. H. Blodgett, plant pathologist at the A. and M. College of Texas discussed the embryology of the duck weed, *Lemna* and exhibited seeds, remarking that though the plant was common the seeds were found seldom. Dr. Caldwell, of Chicago, had worked out the development of *Lemna* to the point of fertilization. Studies made by Dr. Blodgett carried the embryology from this point. The talk was illustrated by diagrams. Discussion followed by Mr. W. L. McAtee.

The first paper of the regular program was by T. H. Kearney: "Native Plants as Indicators of the Agricultural Value of Land." Mr. Kearney outlined the results of field work carried on with Dr. Shantz in the semiarid regions of the United States west of the 98th meridian of longitude. Typical areas were surveyed in Colorado, the Great Basin and in the southwest desert region. Detailed surveys defined the dominant types of vegetation and their distribution, and these were correlated with the varying degrees of salinity, moisture content and other physical properties of the soil. Areas actually under cultivation gave a check as regards productivity. From these studies it is now possible to predict agricultural possibilities by examination of the original types of vegetation in these regions. Typical plant growths and diagrams showing distribution were illustrated by lantern slides.

Mr. Kearney's paper was discussed by Messrs. W. L. McAtee, Wm. Palmer, A. Wetmore and Dr. L. O. Howard.

The last paper of the regular program was by Dr. R. W. Shufeldt: "Comparative Study of Certain Cranial Sutures in the Primates." Dr. Shufeldt stated that no other single vertebrate structure had so much written about it or was receiving more attention at the present time than the skull in man and the primates in general. This study was begun over two thousand years ago and certain names of bones bestowed by Galen in the second century are still retained. In a series of 6,000 human and about 1,000 ape skulls in the collections of the U. S. National Museum Dr. Shufeldt found that while the bones of the face exhibited but little variation, in the bones on the lateral aspect of the cranium were remarkable variations,